CLAIMS

What is claimed is:

1. A reactive filtration method, comprising continuously regenerating a reactive filter media while simultaneously filtering contaminants from fluid flowing through the filter media.

2. The method of Claim 1, wherein regenerating the reactive filter media comprises mixing metal granules with the filter media and agitating the mixture.

3. The method of Claim 1, wherein regenerating the reactive filter media comprises introducing a metal salt reagent into the fluid flowing through the filter media and agitating the filter media.

4. A reactive filtration method, comprising continuously regenerating a reactive filter media while simultaneously filtering contaminants from waste water flowing through the filter media.

5. The method of Claim 4, wherein regenerating the reactive filter media comprises mixing metal granules with the filter media and agitating the mixture.

6. The method of Claim 4, wherein regenerating the reactive filter media comprises corroding a metal in the waste water flowing through the filter media and agitating the filter media.

7. The method of Claim 4, wherein regenerating the reactive filter media comprises introducing a metal salt reagent into the waste water.

8. The method of Claim 7, wherein regenerating the reactive filter media comprises introducing a metal salt reagent into the waste water at a molar ratio of 5:1 to 200:1 with a target contaminant in the waste water.

9. A reactive filtration method, comprising continuously regenerating an iron oxide coated sand bed while simultaneously filtering contaminants from waste water flowing through the sand bed.

10. The method of claim 9, wherein regenerating the sand bed comprises mixing iron granules with sand and agitating the mixture.

11. The method of claim 9, wherein regenerating the sand bed comprises introducing an iron salt reagent into the waste water flowing through the sand bed and agitating the sand.

12. The method of claim 11, wherein introducing iron into the waste water comprises introducing a salt of Fe(II) or Fe(III) into the waste water.

13. A reactive filtration method, comprising passing waste water through a moving mixture of sand and metal granules.

14. A reactive filtration method, comprising introducing a metal ion into waste water and passing the waste water through a bed of moving sand.

15. A method for removing phosphorus, arsenic, selenium or another heavy metal from water, comprising:

introducing a metal salt reagent into the water at a molar ratio of 5:1 to 200:1 to the phosphorous, arsenic, selenium or other heavy metal in the water; and

passing the water through a bed of moving sand.

16. A method for removing phosphorus from water, comprising:

introducing a metal salt reagent into the water at a molar ratio of 5:1 to 40:1 to the phosphorous in the water; and

passing the water through a bed of moving sand.

17. The method of claim 16, wherein introducing a metal salt reagent into the water comprises introducing ferric chloride, ferrous chloride, ferric sulfate or ferrous sulfate into the water at a molar ratio of 5:1 to 40:1 to the phosphorous in the water.

18. A method for removing arsenic from water, comprising:

introducing a metal salt reagent into the water at a molar ratio of 100:1 to 200:1 to the arsenic in the water; and

passing the water through a bed of moving sand.

19. The method of claim 18, wherein introducing a metal salt reagent into the water comprises introducing ferric chloride, ferrous chloride, ferric sulfate or ferrous sulfate into the water at a molar ratio of 100:1 to 200:1 to the phosphorous in the water.

20. A reactive filtration method, comprising:

adding a metal salt reagent to the waste water in sufficient quantity and concentration to allow precipitation reactions between the reagent and a dissolved contaminant to go to at least near completion and to leave unreacted reagent in the water;

flowing the waste water through a serpentine pipe configured to produce more turbulent flow through bends in the pipe and less turbulent flow through straight-aways in the pipe;

controlling the flow rate of waste water through the serpentine pipe to allow precipitation reactions between the reagent and a dissolved contaminant to go to at least near completion while maintaining sufficient flow to inhibit deposition of solids, precipitates or particulates in the serpentine pipe; and then

flowing the waste water through a bed of moving filter media, wherein unreacted metal salt reagent in the waste water reacts with the filter media to generate a reactive metal oxide or hydroxide coating on the filter media to adsorb dissolved contaminants remaining in the waste water.

21. The method of claim 20, wherein the contaminant is phosphorus, arsenic, selenium or another heavy metal and the metal salt reagent is ferric chloride, ferrous chloride, ferric sulfate or ferrous sulfate and the filter media is sand.

22. The method of claim 21, wherein the contaminant is phosphorous and unreacted ferric chloride, ferrous chloride, ferric sulfate or ferrous sulfate in the waste water entering the bed of moving sand provides a molar ratio of iron to phosphorus of 5:1 to 40:1.

23. The method of claim 21, wherein the contaminant is arsenic and unreacted ferric chloride, ferrous chloride, ferric sulfate or ferrous sulfate in the waste water entering the bed of moving sand provides a molar ratio of iron to phosphorus of 100:1 to 200:1.

24. The method of claim 21, wherein the contaminant is arsenic and further comprising, before adding a metal salt reagent, oxidizing the waste water to convert arsenite in the waste water to arsenate.

25. A filtration device, comprising:

a vessel;

a filtration chamber within the vessel;

reactive filter media in the filtration chamber;

a first inlet through which waste water may be pumped into a lower part of the filtration chamber and up through the filter media;

a second inlet through which air may be pumped into the lower part of the filtration chamber;

a recirculation pipe open to and extending vertically up from the second inlet such that an aerated mixture of water and filter media can flow up through the recirculation pipe;

a separator configured to remove the filter media from an aerated mixture of water and filter media flowing through the recirculation pipe; and

an outlet through which filtered water can be removed from the filtration chamber.

26. The device of claim 25, wherein the reactive filter media comprises iron oxide coated sand.

27. The device of claim 25, wherein the reactive filter media comprises a mixture of sand and iron granules.

28. The device of claim 27, wherein the reactive filter media comprises a mixture of 10–30% iron granules by volume and sand.

29. The device of claim 25, wherein the recirculation pipe extends vertically up from the second inlet to a top of the filter chamber through which filter media exiting the separator may return to the filtration chamber.

30. A filtration device, comprising a means for continuously regenerating a reactive filter media while simultaneously filtering contaminants from fluid flowing through the filter media.

31. The device of Claim 30, wherein the means for regenerating the reactive filter media comprises a means for mixing corroding metal granules with the filter media and a means for agitating the mixture.

32. The device of Claim 30, wherein the means for regenerating the reactive filter media comprises a means for introducing a corroding metal in the fluid flowing through the filter media and a means for agitating the filter media.